

Editorial: Deep life, kia ora!

Situated amidst steaming and sulphurous geothermal springs and pools, the 10th International Society for Subsurface Microbiology Conference (ISSM 2017) was held on November 6th–10th, 2017, in Rotorua, New Zealand (<http://issm2017nz.com/>). The meeting brought together some of the most renowned international experts in the field of subsurface microbiology, to discuss exciting recent advances in our understanding of subsurface microbial habitats, processes and ecology. Chaired by Murray Close of the Institute of Environmental Science and Research (ESR), New Zealand, the symposium attracted a fair 135 international students, scholars and practitioners in the field. The session topics included both overarching perspectives of the role of microbes in subsurface ecosystems, biogeochemical cycles and energetics, as well as more focussed elaborations on the interactions of microorganisms with minerals, gases or pollutants. Several habitat-specific sessions on seafloor microbiology, extreme habitats, as well as cave and karst systems were also well-received. Notably, a special session on faecal contamination and human health impacts of groundwater organized by local ESR staff highlighted the significance of science-based decision-making in drinking water use and protection for local communities.

FEMS journals have a previous record of publishing thematic issues connected to ISSM conferences (Harvey 1997; Lueders, Griebler and Häggblom 2012), and the dissemination of relevant research in FEMS Microbiology Ecology continues to be vibrant (<https://academic.oup.com/femsec/pages/vsi.subsurface.microbiology>). Therefore, the Editors of this journal and members of the local organising committee decided to host a thematic issue also for ISSM 2017. The call for papers was widely recognised within the community, reflected by more than 20 research papers now published in the issue, submitted either by conference participants, previous ISSM attendants, or interested colleagues in the field.

The range of subsurface habitats investigated and research topics discussed during the conference is more than adequately reflected in the manuscripts now collated in this issue. This starts from the investigation of diversity, viability and temporal adaptations of microbes in the deep terrestrial biosphere (Lopez-Fernandez et al. 2018; Magnabosco et al. 2018; Purkamo et al. 2018), where authors provide new insights into deep life mostly dominated by microorganisms with lithotrophic metabolisms. Several studies investigate microorganisms in high-temperature and/or faulting associated habitats, such as thermal waters, hot springs and mud volcanoes, showcasing the (partially undescribed) microbial diversity and also biogeochemical roles that can be discovered for microorganisms in such extreme habitats

(Kadnikov et al. 2018; Lin et al. 2018; Stewart et al. 2018). Furthermore, questions of reservoir microbiology are addressed in this issue, where indigenous microbiomes of Albertan oil sands and microbial aspects of CO₂-enhanced oil recovery are investigated (Ridley and Voordouw 2018; Shelton et al. 2018). Questions of hydrocarbon degradation and pollutant attenuation are also addressed for shallow groundwater systems, where researchers have used integrated 'omics approaches and/or stable isotope probing to characterise degraders of chlorinated and aromatic hydrocarbons, as well as of complex landfill contaminations (Liu et al. 2018; Táncsics et al. 2018; Taş et al. 2018). The attenuation of inorganic mine tailings in northern, so-called 'treatment peatlands' is investigated (Kujala et al. 2018) and, as arguably one of the most relevant groundwater pollutants in rural landscapes, the elimination of nitrate is shown to be possible in oligotrophic groundwater via chemolithoautotrophic processes (Bellini et al. 2018; Kumar et al. 2018).

Nitrifying members of the *Thaumarchaeota* are shown to play a potentially important role in oxidative nitrogen cycling in a semi-arid cave (Kimble et al. 2018). Microbe–mineral interactions are traced to the cellular level on iron oxide minerals and riverine gold deposits using NanoSIMS and other advanced chemical imaging technologies (Newsome et al. 2018; Rea et al. 2018). An innovative cultivation-based screening approach is used to unravel complex interspecies interactions, both growth promoting and antagonistic, between karstic bacterial isolates and widely used laboratory microbes (Geesink et al. 2018). Further methodological advance is presented by Luk, Beckmann and Manefeld (2018), propagating a better awareness and more rigour in the quantitative interpretation of rRNA gene sequencing libraries from groundwater. The issue is also pleased to publish no less than two different contributions to the long-lasting discussion on whether groundwater microbiota can be useful as indicators for anthropogenic ecosystem impact (Sirisena et al. 2018; Smith et al. 2018). And as a very valuable addition to the abundant work that has been done for marine sediments, Vuillemin et al. (2018) provide a high-resolution inventory of microbiomes from deep lacustrine sediments, and how this can be correlated to climate intervals over the last 50 000 years.

On a personal level, we would like to take the opportunity to memorize our good friend and fellow subsurface microbiologist Wilfred F.M. Röling, who had been a steady attendant and important contributor to the ISSM conferences, but who sadly departed in 2015 (Smidt 2015). We were carrying his memory with us while we were talking a walk through the magnificent New Zealand outdoors! It is an honour for this ISSM thematic issue to include the latest, and probably the last, of Wilfred's

careful dissections of landfill leachate-impacted microbiomes at the well-known Banisveld site (Taş et al. 2018).

The conference organizers and special issue editors are grateful to all the prominent subsurface microbiology groups that contributed their work to this thematic issue, and to the many anonymous reviewers who helped greatly in guaranteeing the scientific quality of the published manuscripts. Kia ora and we hope to see all of you again at the next ISSM conference, taking place in June 2020 in Utrecht, NL (<https://www.issm2020.com/>).

Conflict of interest. None declared.

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